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REGION VII, KANSAS

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SECTION II

EXPERIMENTAL PROCEDURES

SAMPLING PROCEDURES

Based on results of the sampling and recovery studies, grab sampling was used as the primary method of sampling water. Water samples were composited and stored in glass gallon bottles (previously used for pesticide grade solvents). The samples were stored in ice chests and returned to MRI for analysis. Supplemental water sampling was done by drawing water through an Amberlite XAD-4 glass column (250 g) with a mechanical pump. When the sampling was completed, the Amberlite XAD-4 column was capped at both ends and stored in ice chests until ready for analysis.

Air was sampled through a 37 mm diameter, 0.8 μ m pore size, millipore filter, followed by a 15 cm, 1.2 cm i.d., glass sampling tube* packed with 1 g Tenax[®]-GC. Air was drawn through the filter and Tenax[®]-GC tube with the aid of a mechanical pump. The flow rate was regulated with either an 18 gauge needle (~ 3.5 liter/min) or a 26 gauge needle (~ 0.4 liter/min). A schematic of the air sampling train is shown in Figure 1.

* In sampling some industrial plants, two Tenax[®]-GC tubes were used in tandem.

*Pls. copy
this report.
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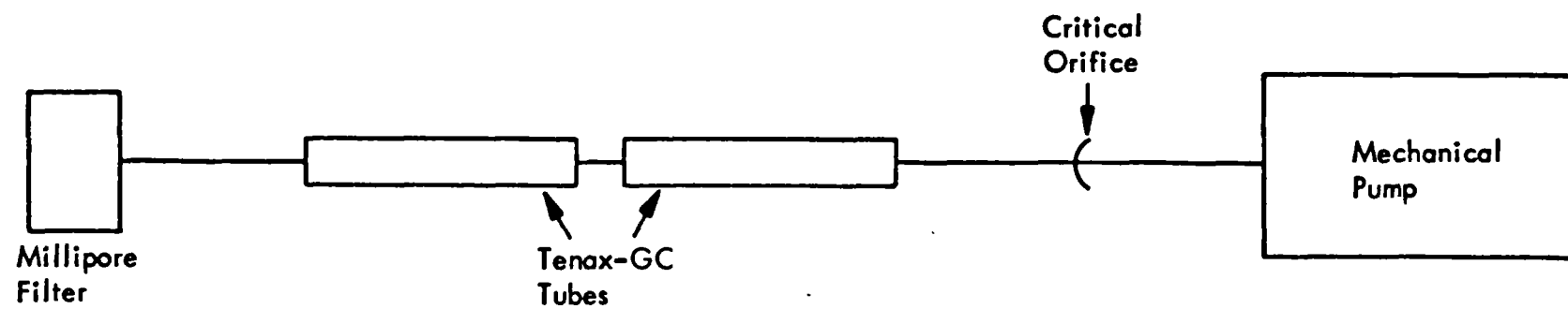


Figure 1. Air sampling train

After sampling, each tube and filter was carefully packed, capped and stored in ice chests until ready for analysis.

Soil and sediment samples were composited, and stored in widemouth glass bottles with Teflon-lined caps, and kept in ice chests until ready for analysis.

ANALYSIS PROCEDURES

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Sample Preparation

For each air sample, the millipore filter, and the Tenax[®]-GC resin, were extracted separately in an ultrasonic bath, each with three portions (20, 20, 10 ml) of pesticide grade n-hexane (Matheson, Coleman, and Bell) for a period of 10 min, and made up to the mark of a 50 ml volumetric flask. During the extraction, ice chips were placed in the ultrasonic bath so that evaporative losses of HCB and HCBD were minimized.

The soil samples were first sifted on a U.S. Standard No. 18 sieve to remove stones and other foreign material. A known amount was then weighed and extracted with n-hexane in a soxhlet apparatus overnight. Each extract was made up and stored in 100-ml volumetric flasks. A similar sample preparation procedure was used on sediment samples except that the sifting step was omitted.

For water, grab samples were extracted with two 20-ml volumes of n-hexane followed by one 10-ml volume using a 500-ml separatory funnel. The three extracts were combined and made up to the mark in a 50-ml volumetric flask.

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The Amberlite XAD-4 resin was Soxhlet extracted with an appropriate volume of n-hexane. The extract was stored in a 250-ml volumetric flask.

During the analysis, dilution or concentration of the samples was performed, as necessary, to bring the instrument response to within the linear range of the calibration curve.

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Instrumentation and Conditions

A Microtek-2000R gas chromatograph equipped with an electron capture detector (tritium) was used. The output of the gas chromatograph was connected to a Hewlett-Packard 3380A integrator-recorder, which features the printout of the chromatogram with integrated areas of individual peaks and respective retention times. A 4 ft x 1/4 in. glass column packed with 1.5% OV-17/1.95% QF-1 coated on 100/120 mesh Supelcoport® was used as the primary column for analysis; a 6 ft x 1/4 in. glass column packed with a 3% XE-60 coated on 80/100 mesh Chromosorb WHP was used to verify and differentiate HCB from α -BHC.

For HCBd analysis, the chromatographic operating conditions were: injector temperature, 200°C; column temperature, 100°C; detector temperature, 180°C; carrier flow rate, 50 ml/min nitrogen; purge flow rate, 90 ml/min nitrogen; and detector voltage, 10 V DC.

For HCB analysis, the chromatographic operating conditions were the same as those for the analysis of HCBd except that the column temperature was maintained at 150°C; carrier flow rate, 100 ml/min nitrogen; and purge flow rate, 90 ml/min nitrogen.

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The instrumental limit of detection at the above mentioned conditions was 1 pg (10^{-12} g) for HCB and 2 pg (2×10^{-12} g) for HCB. Therefore, as an example, for any amount of air sampled, the quantity of HCB and HCB in the sample required for detection was greater than 5 and 10 ng, respectively (based on 10 μ l injections of a 50-ml solution).

Calibration

A 10 ng/ml composite standard solution of HCB and HCB was used to obtain the calibration curves. The standard solution was prepared by dilution of a stock solution made up from EPA reference standards obtained from Pesticides and Toxic Substances Effects Laboratory, National Environmental Research Center, Research Triangle Park, North Carolina. Concentration ranges chosen for the calibration curve were from 10 to 60 pg, and linearity was observed.

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SECTION V

DISCUSSION OF RESULTS AND CONCLUSIONS

Air, soil, water, and sediment samples were collected from nine recommended industrial plants whose products included perchloroethylene, trichloroethylene, carbon tetrachloride, triazine herbicides, pentachloronitrobenzene and chlorine. In general, HCB and HCBd concentrations varied from a maximum, near the production and waste disposal areas, to a minimum, in the samples taken upwind. However, in a few instances, HCB contamination was observed over the general plant area and a specific emission source was difficult to determine. HCB was detected as a vapor and a particulate; the predominate form was dependent upon the production and waste disposal methods of each plant. HCBd was detected as a vapor in every case. The results from each sampling site are discussed below.

VULCAN MATERIALS COMPANY, WICHITA, KANSAS

Field sampling at Vulcan Materials Company's perchloroethylene plant at Wichita, Kansas, was conducted on May 20, 1975. Other compounds of interest produced at this plant include carbon tetrachloride and chlorine. The samples collected were: 180 air (90 filters and 90 Tenax[®]-GC columns), 10 solid, and 4 water. A summary of results for this plant is given in Table 5.

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Table 5. SUMMARY OF ANALYTICAL DATA FROM VULCAN MATERIALS COMPANY,
WICHITA, KANSAS

Site: Vulcan Materials Company, Wichita, Kansas

Sample	Air ($\mu\text{g}/\text{m}^3$)		Water ($\mu\text{g}/\text{l}$)		Soil ($\mu\text{g}/\text{g}$)		Sediment ($\mu\text{g}/\text{g}$)	
	High	Low	High	Low	High	Low	High	Low
HCB	29	0.53	310	0.009	5%	1.1	No Sample	
HCBD	560	0.05	231	ND	980	0.005	No Sample	

Products:

Perchloroethylene
Chlorine
Carbon Tetrachloride

Waste Disposal:

Landfill and deepwell

Air Samples

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The 180 air samples were collected from 18 samplers which were positioned upwind (3), immediately downwind of the general production and waste storage areas (9), and further downwind beyond the northern plant boundary (6). The latter six samplers were positioned at three locations with two samplers per location at 4 and 11 ft above ground, respectively. The upwind and farthest downwind samplers were operated continuously for a 4-hr period while those closer to the general production and waste storage area were operated only for the first hour of each 4-hr period. After each 4-hr period, the filter and the Tenax®-GC column in each sampler were replaced by fresh components. The sampling strategy was designed so that results of the analysis would elucidate: (a) the major sources and level of HCB and HCBd emission, (b) the diurnal and operation-related effects of HCB and HCBd emission, (c) the physical form, i.e., particulate or vapor of HCB and HCBd in the plant air, and (d) the variation of HCB and HCBd concentrations with respect to sampler distance above ground.

Sources and Levels of HCB and HCBd Emissions - The analytical data for the 180 air samples are tabulated in Table B-1 of Appendix B. Figure 4 shows the average concentrations of HCB and HCBd during the 20-hr sampling period at the 18 sampling stations. It is obvious that major sources of HCB and HCBd in the air are the production and waste storage ("Hex Pit") areas. In addition, other sources of HCB are indicated by the upwind air concentrations. HCBd concentrations in the

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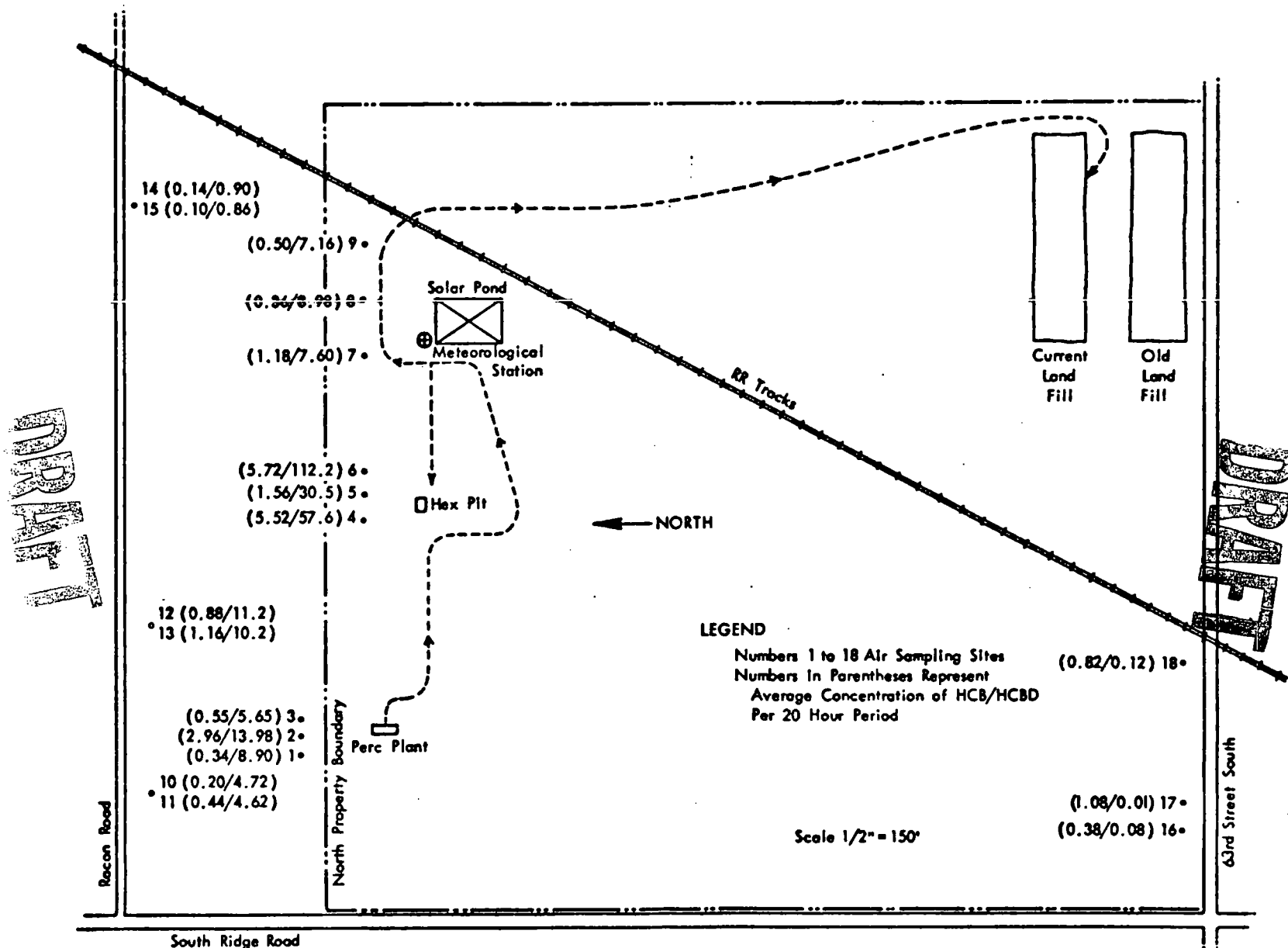


Figure 4. Average concentrations ($\mu\text{g}/\text{m}^3$) of HCB and HCBD in air per 20-hr period at 18 sampling stations at Vulcan Materials Company, Wichita, Kansas

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air samples taken beyond the northern plant boundary are approximately 20 times greater than corresponding HCB concentrations which is not surprising in view of the relative volatilities of the two compounds.

The average HCB levels in samples immediately downwind of the production and storage areas ranged from 0.1 to $24 \mu\text{g}/\text{m}^3$. The levels of HCB in the upwind samples and samples taken downwind beyond the northern plant boundary were similar and in the range of 0.1 to $2.1 \mu\text{g}/\text{m}^3$.

HCB levels were highest, ranging up to $460 \mu\text{g}/\text{m}^3$, in samples taken near the "Hex Pit;" the average HCB concentration in that area was approximately $65 \mu\text{g}/\text{m}^3$. The average HCB concentration in all samples taken from the seven stations north of the plant boundary, downwind of the production and waste holding ("Hex Pit") areas, was approximately $8 \mu\text{g}/\text{m}^3$. Only trace levels of HCB were detected in upwind samples.

Variation of HCB and HCB Emission with Time - The variation of HCB and HCB levels over the 20-hr sampling period is shown in Figures B-1 through B-6 in Appendix B.

Figure B-1 shows that the HCB levels in air samples immediately downwind of the production and waste storage area did not increase following the dumping of the "hex residue" at the "Perc Plant" or the "Hex Pit." The increase in HCB at Stations 4 and 6 occurred either

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prior to or significantly after dumping. However, Figure B-2 shows that HCB levels appear to reflect plant activity, i.e., dumping of "hex residue." This is especially true in sampling stations near the "Hex Pit."

The variation of HCB and HCB levels in samples beyond the plants' northern boundary are shown in Figures B-3 and B-4, respectively. Each point is the average of two samplers positioned at different heights (4 and 11 ft). Figure B-4 indicates that the HCB level increased at Stations 12 and 13 during hex dumping.

Figure B-5 shows that during the entire sampling period, HCB levels were relatively high in upwind Stations 16, 17, and 18; in fact, the 20-hr average values were greater than some of the downwind stations. Among the three stations, higher concentrations were detected at Stations 17 and 18 which were closer to the landfill than Station 16.

The low levels detected in upwind samples during the entire sampling period indicate that the major source of HCB is vapor from the "Hex Pit" and production plant and not from the buried wastes or plant area soil.

Physical Form of HCB and HCB - The average vapor and particulate concentrations of HCB over the 20-hr sampling period at each station are shown in Figure B-7. The physical state of the HCB detected was dependent upon the sampling location. Particulate HCB was not detected in

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samples taken near the solar pond (Stations 7, 8, and 9) and at the northeast corner (Stations 14 and 15), northwest corner (Stations 10 and 11) and southwest corner (Station 16) of the sampling area. At all other sampling stations, particulate HCB was approximately equal to or much greater than (Stations 4, 5, and 6) the HCB detected as a vapor.

The variation of HCB levels over the 20-hr period in samples taken near the "Hex Pit" is due almost entirely to variation in particulate levels. Figure B-8 shows the HCB vapor concentration at Station 4 is relatively constant, near the $1 \mu\text{g}/\text{m}^3$ level, whereas the particulate level fluctuates from 0 to $10 \mu\text{g}/\text{m}^3$. Particulate HCB was not observed during the 0110 to 0220 and 0450 to 0550 sampling periods when vehicular activity was probably low; particulate levels were $5 \mu\text{g}/\text{m}^3$ or higher during the periods of 1945 to 2045, 0902 to 1010, and 1307 to 1425. Figure B-9 shows a similar, but less pronounced pattern for upwind Station 18; the vapor HCB ranges from approximately 0.3 to $0.7 \mu\text{g}/\text{m}^3$ while the particulate HCB varies from 0 to $1.2 \mu\text{g}/\text{m}^3$.

All samples showed a relatively constant HCB vapor concentration during the entire sampling and fluctuating HCB particulate concentration (when detected) that probably reflects the activity in the immediate area of the sampling stations. A slight increase in HCB vapor concentration during the warmer sampling periods was observed at some

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sampling stations (Figure B-9). This increase was not apparent until the particulate and vapor concentrations were considered separately.

HCB and HCBd Concentrations Versus Sampler Heights - Figures B-10 through B-12 in Appendix B show the comparisons of samples collected at the same sampling location, but at two different heights, 4 and 11 ft, respectively, for each of the five time periods. The sampling locations are Stations 10 and 11, 12 and 13, and 14 and 15. The results indicate that the differences in levels at the two heights was not significant.

Precision of Sampling and Analysis - The agreement between each of the sample sets is excellent for both HCB and HCBd. The largest variation was observed between Stations 12 and 13 for one particular sampling period-- 1124 to 1433 hr. This discrepancy was due entirely to differences in the filter analyses, 980 ng in Station 13 versus 18 ng in Station 12; the quantities of HCB detected in the Tenax[®]-GC resin were approximately equal, 280 ng versus 260 ng.

If it is assumed that the HCB and HCBd levels were the same at the two sampler heights (4 and 11 ft), the results from each paired station, i.e., 10 and 11, 12 and 13, and 14 and 15, at each of the five sampling periods can be considered as duplicates and a pooled relative standard

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deviation (PRSD)* determined. The PRSD calculated from these data indicates the overall precision of the air sampling and analysis methods including sample collection, storage, recovery, and analysis. The PRSD's were: HCB, 17%; and HCBd, 14%. The PRSD's are based on 13 duplicates each for HCB and HCBd. Four duplicate measurements were not included in the calculations: two HCBd and one HCB near the detection pairs were near the detection limit ($< 0.1 \mu\text{g}/\text{m}^3$) and the HCB station with the high particulate mentioned above was considered an outlier.

Soil Samples

The nine soil samples and one "Hex Pit" solid sample were collected at the following locations: along the plant boundaries, transportation routes, landfill, the "Hex Pit" area and the production area. These sites were selected to determine HCB and HCBd soil levels associated with production waste disposal and transportation of wastes for disposal. Sample were also taken upwind and in adjacent agricultural fields to determine background concentrations in areas in the vicinity of the plant.

The results of the analysis of the nine soil and one solid samples, tabulated in Table B-2, indicate that HCB and HCBd soil concentrations

* The PRSD was calculated as follows:

$$s = \sqrt{\sum_{i=1}^n (x - \bar{x})^2 / 0.889}$$

$$\text{RSD} = s / \bar{x} \times 100$$

$$\text{PRSD} = \sqrt{\sum_{i=1}^n \text{RSD}_i^2 / n}$$

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were generally in the parts per million and parts per billion range, respectively; with the exception of the "Hex Pit" soil and the "Hex Pit" solids. HCB is 5% in the "Hex Pit" soil* and 21% in the "Hex Pit" solids, while HCB_D is 0.1% in the "Hex Pit" soil and 10% in the "Hex Pit" solids.

Specifically, of the four plant boundaries, the highest levels of HCB and HCB_D, 126 and 0.106 ppm, respectively, were observed in soil from the southern boundary (S-8). On the other three boundaries, levels of the two substances ranged from 1.1 to 1.3 ppm for HCB and 0.005 to 0.030 ppm for HCB_D.

The observation of relatively high concentrations of HCB and HCB_D in the southern boundary soil sample (S-8) could very well be the source of high concentrations of HCB in the air samples collected at Air Sampling Stations 16 through 18. The high concentrations in upwind soil samples (S-8) could be due to the nearby landfill. This rationale is supported by the presence of over 1,000 ppm of HCB and 0.36 ppm of HCB_D found in the S-5 sample, which indicates the landfill is a source of surface contamination in the immediate area.

* Taken from a 10-ft radius of the "Hex Pit."

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Over 100 ppm of HCB and 0.22 to 2.2 ppm of HCBd were observed in the soil on the route to the "Hex Pit" (S-2) and in the soil from the "Hex Pit" to the landfill (S-4). The high concentrations of HCB and HCBd found in the "Hex Pit" solids were expected since the "hex residues" consist of mainly HCB and HCBd. Results of the analyses of air samples collected in Air Sampling Stations 4, 5, and 6 showed consistently high concentrations of the two substances (see Figure 4). Furthermore, concentrations of the two substances found in the water layer covering the "Hex Pit" are also relatively high. The results of the water analysis are presented below.

Water Samples

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Two samples were taken from Cowskin Creek (Figure A-3) which receives water from the sanitary sewer system and plant heat exchangers. Samples were taken from the "Hex Pit" and "Solar Pond" to determine their contribution to HCB and HCBd levels in air and into the deep well which receives water from the "Solar Pond."

The results of the analyses are shown in Table B-3. The levels of HCB and HCBd were relatively low--particularly in the Cowskin Creek water, parts per trillion for HCB and nondetectable for HCBd.

The presence of high levels of HCB (306 ppb) and HCBd (231 ppb) in the "Hex Pit" water is expected since this water was used to cover the "hex residues" dumped in the pit. This water should be saturated

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with HCB and HCBD. Amounts of HCB and HCBD in the "Solar Pond" are two orders of magnitude lower than that in the "Hex Pit" water. The source of these two substances in the "Solar Pond" water could be from leaching of the soil or from vapor or airborne particulate from the neighboring "Hex Pit."

Conclusions

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The results of the analysis of all air, soil, and water samples indicate that the "Hex Pit" is the source of the highest levels of HCB and HCBD. HCB is present in particulate and vapor form in air samples taken from within the plant area; HCBD is present as a vapor only. The HCB detected in the downwind air samples beyond the plant perimeter was present mainly as a vapor. There appears to be a relatively constant air concentration of HCB vapor of approximately 0.1 to $1.0 \mu\text{g}/\text{m}^3$ even in the upwind air samples. This background level of HCB in air may be due to the HCB present in the general plant area soil and landfill.

The variation in HCB levels over the sampling period was due primarily to variations in HCB detected in particulates. Variations in HCBD levels of a number of downwind samples were related to dumping of solid "hex residues."

HCB concentrations in soil (excluding the "Hex Pit" area) ranged from 1 to 1,500 ppm; HCBD concentrations were significantly lower (≤ 2 ppm).

The water samples taken beyond the plant area from Cowskin Creek contained very low levels of HCB (parts per trillion range) and HCB_D was not detected. Downstream levels of HCB were twice as high as upstream levels.

LINDEN CHLORINE PLANT, LINDEN, NEW JERSEY

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The survey of Linden Chlorine Plant was conducted on May 29, 1975. During the intended presampling survey, it was apparent that an extended air sampling plan was not warranted. Therefore, sediment, water, and soil samples were taken during the survey.

The Linden Plant was selected as a tentative sampling site because graphite electrodes were used in the production of chlorine and the plant produced a single product. During our visit we learned that graphite electrodes had been phased out at the end of March 1975.

Seven water and four solid samples were analyzed for HCB and HCB_D. The results are listed in Table B-4. A summary of results is given in Table 6.

The results indicate that parts per trillion levels of HCB_D were present in the holding pond (inlet and outlet), spent brine, and the upstream and downstream water of the plant. HCB was detected only in the spent brine water, at 0.34 µg/liter. Based on the instrumental detection limit for HCB, 2 pg (2×10^{-12} g); the volume of water extracted, 1 liter; and the final extract volume, 50 ml; the minimum detectable concentration of HCB in water is 10 parts per trillion.

Presampling surveys and field sampling were conducted on the recommended industrial plants according to the schedule shown in Figure A-1. Essentially, during the presampling survey, information such as the surrounding terrain, meteorological conditions, production technology, and waste disposal technique was gathered. Following each site visit, a detailed field sampling strategy was devised and carried out approximately 2 to 4 weeks after the presampling survey date. Presented below are detailed descriptions of the presampling survey and field sampling conducted at each plant.

VULCAN MATERIAL COMPANY, WICHITA, KANSAS

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PRESAMPLING SITE SURVEY

The presampling site survey at Vulcan Materials Company's Wichita, Kansas, plant was conducted on May 6, 1975. The following personnel were present:

Mr. J. I. Jordan, Jr.	Manager, Research and Development, Vulcan Materials Company
Mr. R. A. Bondurant, Jr.	Director, Environmental Control Safety, Vulcan Materials Company
Mr. Dave Harrison	Acting Technical Manager, Wichita Plant, Vulcan Materials Company
Mr. P. Constant	Midwest Research Institute
Mr. P. Kuykendall	Midwest Research Institute
Dr. J. Spigarelli	Midwest Research Institute

Vulcan Materials Company is located approximately 7 miles southwest of downtown Wichita and approximately 4 miles from any major residential area. The surrounding terrain is level with only one nearby water source, Cowskin Creek. The prevailing wind in May is generally from the south, southeast or southwest.

Perchloroethylene is produced by the reaction of hydrocarbons and chlorine. The hydrocarbons are generally of a widely variable composition and are obtained from many sources. The chlorine is produced by Vulcan and piped directly from their liquification station to the perchloroethylene reaction pot. Their chlorine production utilizes diaphragm cells and approximately 25% of their anodes are graphite, the remainder being dimensionally stabilized anodes.

	May	June	July	August	September
Vulcan Materials Wichita, Ks.	▲ —				
Linden Chlorine Linden, N.J.	▲ —				
Stauffer Chemical Louisville, Ky.	▲	—			
Dow Chemical Pittsburg, Calif.		▲		—	
du Pont Corpus Christi, Tex.			▲	—	
Diamond Shamrock Deer Park, Tex.			▲	—	
Ciba-Geigy Corp. St. Gabriel, La.			▲	—	
Olin Corp. McIntosh, Ala.			▲	—	
Kaiser Aluminum Gramercy, La.				▲	
PPG Industries Lake Charles, La.				▲	—

▲ Presampling Visit

— Field Sampling

Figure A-1. Presampling survey and field sampling schedule

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Vulcan uses two types of waste disposal, deep wells and landfills. The deep wells are used for the disposal of storm runoff, while the landfills are used for the disposal of "heavy ends" waste from perchloroethylene production. The residues are collected in a sealed vessel, transferred to another sealed vessel mounted on a trailer, and transported to an open pit where they are stored under water. When the residue level in the pit reaches a certain level, it is transferred by means of a backhoe to a dump truck and transported to the landfill, which is located southeast of the plant. There it is dumped, covered with polyethylene sheeting, then covered with dirt.

At the conclusion of the presampling survey, it was agreed upon that field sampling would be tentatively scheduled in the week of May 19, 1975.

FIELD SAMPLING

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Field sampling at the Vulcan plant was conducted on May 20, 1975. Air, soil, and water samples were collected as planned. Detailed description of the sampling, plant activities, and weather conditions, are discussed below.

Air Sampling

Five general areas were chosen for air sampling: (a) perchloroethylene plant; (b) "Hex Pit;" (c) solar pond - landfill; (d) downwind of these locations; and (e) upwind of these locations. The total sampling time was divided into 4-hr periods. The upwind and downwind samplers were operated continuously during each 4-hr period, whereas all other samplers were operated only for the 1st hr of each 4-hr period. Each sampling location is shown in Figure A-2. Exact location was measured with respect to the suspected emission source and was reported along with other sampling data in Table A-1.

Soil Sampling

Soil sampling covered eight general areas:

- S-1 Around the perchloroethylene plant
- S-2 Route from perchloroethylene plant to "Hex Pit"
- S-3 Around the "Hex Pit"
- S-4 Route from "Hex Pit" to landfill
- S-5 Between old and current landfill sites

A-5

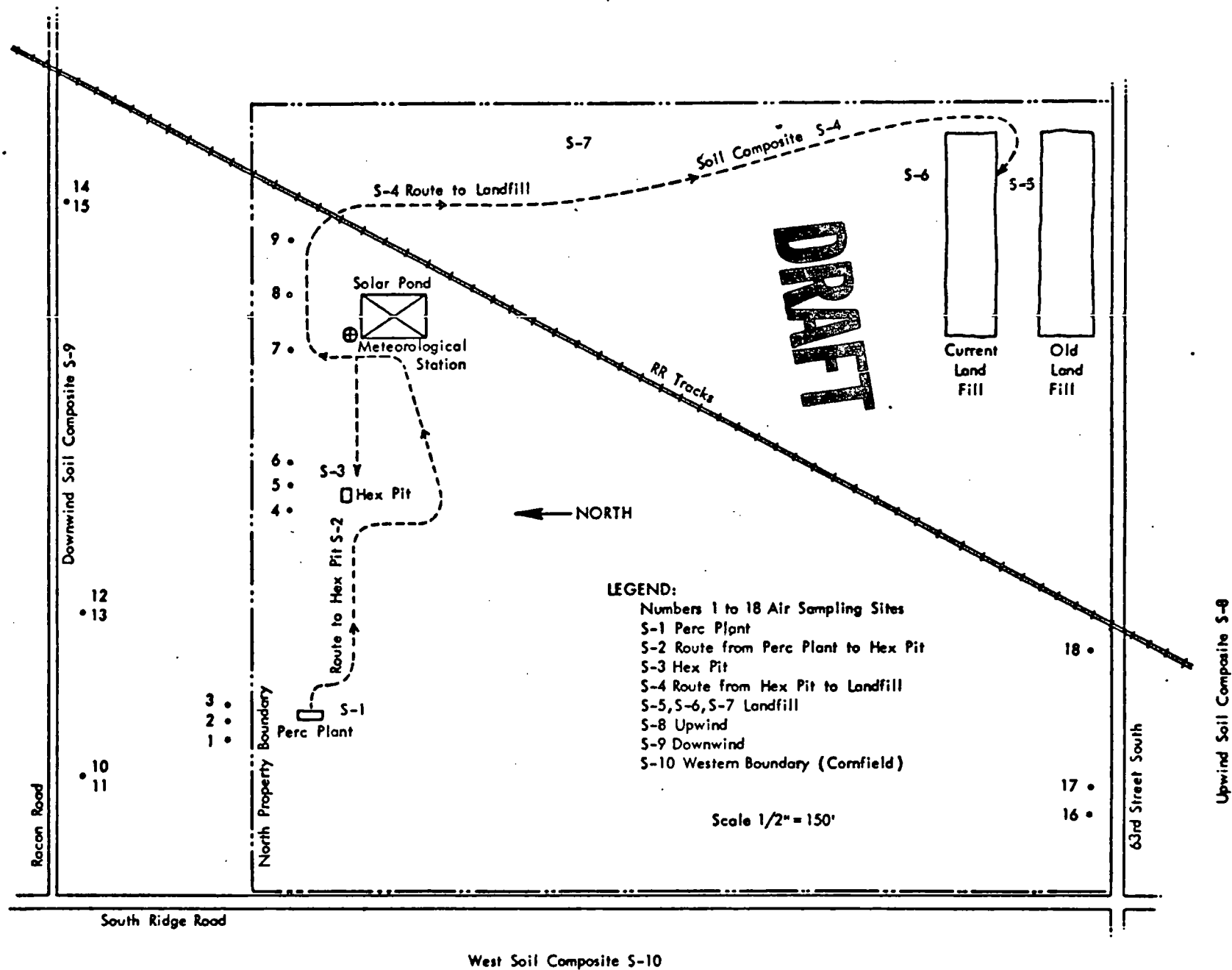


Figure A-2. Sampling locations at Vulcan Materials Company - Wichita plant

Table A-1. AIR SAMPLING DATA AT VULCAN MATERIALS COMPANY, WICHITA, KANSAS

<u>General area</u>	<u>Sample no.</u>	<u>Exact location</u>	<u>Sampling period</u>	<u>Total sampling time (hr)</u>	<u>Sampling rate (l/min)</u>	<u>Total sample vol. (l)</u>	<u>Sampler height (ft)</u>
"Perc Plant"	1	250 ft north of "Perc Plant"- 250 ft west of Sample No. 2	1st hr of 4 hr	19.5	0.5	178	11
	2	250 ft north of "Perc Plant"	1st hr of 4 hr	19.5	0.5	149	11
	3	250 ft north of "Perc Plant"- 50 ft east of Sample No. 2	1st hr of 4 hr	19.5	0.5	207	11
"Hex Pit"	4	150 ft north of "Hex Pit" 75 ft west of Sample No. 2	1st hr of 4 hr	19.5	0.5	156	4
	5	150 ft north of "Hex Pit"	1st hr of 4 hr	19.5	0.5	232	4
	6	150 ft north of "Hex pit"- 75 ft east of Sample No. 2	1st hr of 4 hr	19.5	0.5	195	4
Solar pond- landfill	7	1,500 ft north of landfill- 225 ft northwest of solar pond	1st hr of 4 hr	19.5	3.5	813	4
	8	1,500 ft north of landfill- 225 ft north of solar pond	1st hr of 4 hr	19.5	3.5	1,123	4
	9	1,500 ft north of landfill- 440 ft northeast of solar pond	1st hr of 4 hr	19.5	3.5	1,198	4
Downwind	10 and 11	525 ft north of plant boundary- 340 ft east of Ridge Road	4 hr	19.5	3.5	3,646	10-4
	12 and 13	525 ft north of plant boundary- 850 ft east of Ridge Road	4 hr	19.5	3.5	3,862	11-11
	14 and 15	525 ft north of plant boundary- 850 ft east of Ridge Road	4 hr	19.5	3.5	3,930	12-4
	16	525 ft north of plant boundary- 2,100 ft north of Ridge Road	4 hr	19.5	3.5	4,172	13-11
	17	525 ft north of plant boundary- 2,100 ft north of Ridge Road	4 hr	19.5	3.5	4,291	14-4
	18	525 ft north of plant boundary- 2,100 ft north of Ridge Road	4 hr	19.5	3.5	4,272	15-11
	19	On southern plant boundary- 225 ft east of Ridge Road	4 hr	19.5	3.5	3,744	4
	20	On southern plant boundary- 300 ft east of Ridge Road	4 hr	19.5	3.5	3,176	4
	21	On southern plant boundary- 700 ft east of Ridge Road	4 hr	19.5	3.5	3,353	4

- S-6 North of current landfill site
- S-7 Along the eastern plant boundary
- S-8 Along the southern plant boundary, passed 63rd Street
- S-9 Beyond the northern plant boundary, along Racon Road
- S-10 Along the western plant boundary, along the cornfield

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All the samples were composites except the landfill samples. In addition, a sample of the "Hex Pit" solids was also collected.

Water Sampling

Water samples were taken from four general areas:

1. Upstream from waste inflow - Cowskin Creek
2. Downstream from waste inflow - Cowskin creek
3. Solar pond water
4. "Hex Pit" water

The location of the solar pond and "hex" pit is shown in Figure A-2; the sampling locations in Cowskin Creek are shown in Figure A-3.

Samples from Cowskin Creek were collected on Amberlite XAD-4 resin via a battery-operated pump. Grab samples were taken from the solar pond and "Hex Pit."

Plant Activities and Weather Conditions

Plant activities were observed during the sampling period and are tabulated in Table A-2.

The weather conditions during the sampling period are summarized in Table A-3. Fortunately, the wind was from the south or southeast during the entire sampling period except for the last 4-hr interval. The change in wind direction coincided with a thunderstorm which forced a termination of sampling during the final 4-hr period.

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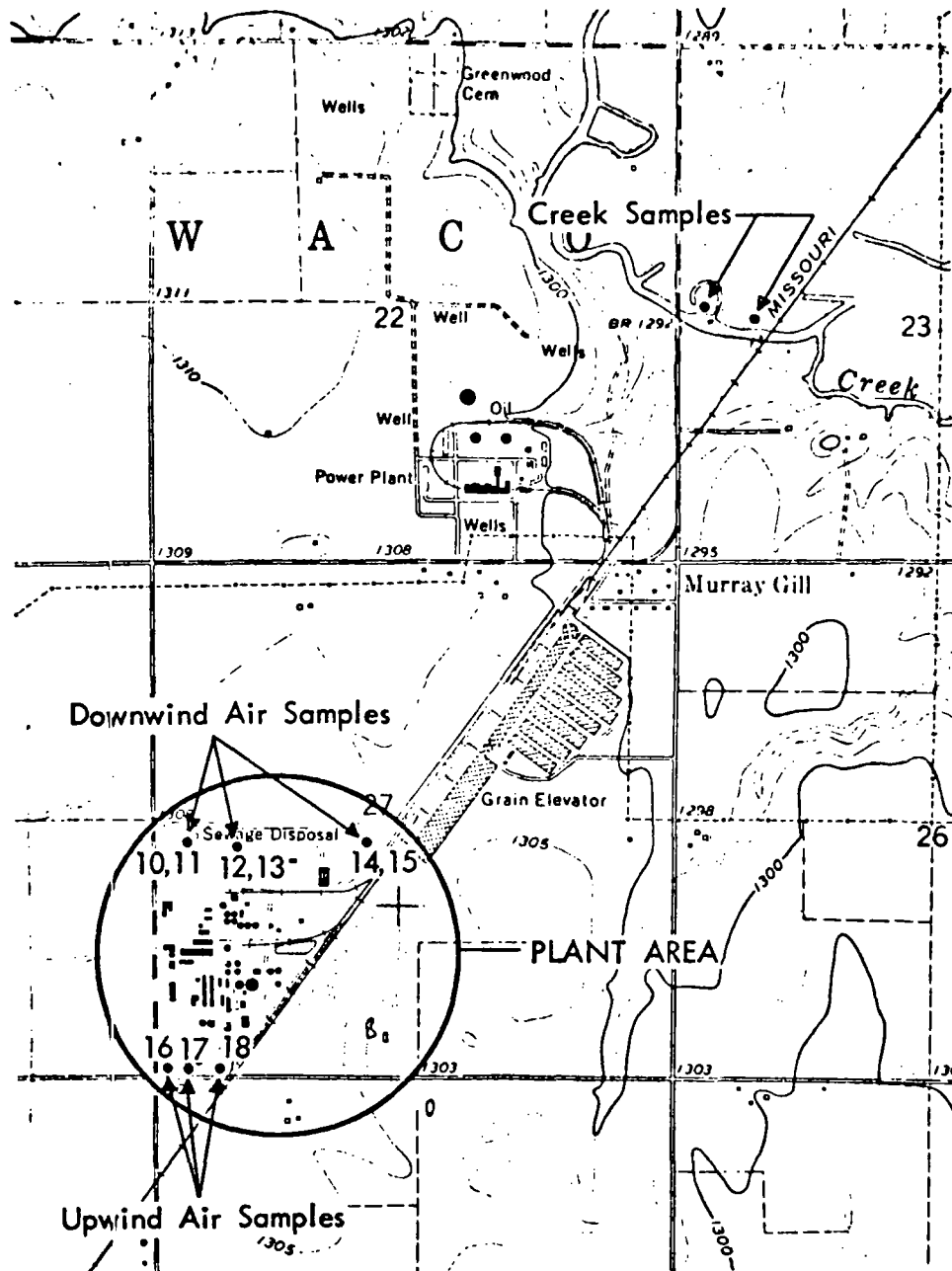


Figure A-3. Vulcan Materials Company - Wichita plant, and surrounding areas (2.6 in. = 1 mile)

Table A-2. PLANT ACTIVITIES DURING SAMPLING AT VULCAN MATERIALS COMPANY,
WICHITA, KANSAS

<u>Time</u>	<u>"Perc plant"</u>	<u>Hex pit"</u>	<u>Solar pond landfill</u>	<u>Downwind</u>	<u>Upwind</u>
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<u>May 21</u>					
1900	Normal	Fuller than usual	Normal	Normal	Normal
2000	Normal	Fuller than usual	Normal	Normal	Normal
2100	Normal	Fuller than usual	Normal	Normal	Normal
2200	Normal	Fuller than usual	Normal	Normal	Normal
2300	Normal	Fuller than usual	Normal	Normal	Normal
2400	Dumped "Hex"	Fuller than usual	Normal	Dumped "Hex"	Normal
<u>May 22</u>					
0100	Normal	Dumped "Hex"	Normal	Dumped "Hex"	Normal
0200	Normal	Normal	Normal	Normal	Normal
0300	Normal	Normal	Normal	Normal	Normal
0400	Normal	Normal	Normal	Normal	Normal
0500	Normal	Normal	Normal	Normal	Normal
0600	Normal	Normal	Normal	Normal	Normal
0700	Normal	Normal	Normal	Normal	Normal
0800	Normal	Normal	Normal	Normal	Normal
0900	Normal	Normal	Normal	Normal	Normal
1000	Normal	Normal	Normal	Normal	Normal
1100	Normal	Normal	Normal	Normal	Normal
1200	Normal	Normal	Normal	Normal	Normal
1300	Dumped "Hex"	Normal	Normal	Dumped "Hex"	Normal
1400	Normal	Dumped "Hex"	Normal	Dumped "Hex"	Normal
1500	Rain	Rain	Rain	Rain	Rain

Table A-3. WEATHER CONDITIONS DURING SAMPLING AT VULCAN MATERIALS COMPANY, WICHITA, KANSAS

Time	Temperature (°C)	Barometric pressure (mm Hg)	Precipitation	Wind	
				Speed	Direction
May 21					
1900	27	722	None	15	South southeast
2000	27	722	None	12	South southeast
2100	24	723	None	11	Southeast
2200	23	724	None	12	Southeast
2300	23	724	None	13	South southeast
2400	23	724	None	12	South
May 22					
0100	23	724	None	11	South southeast
0200	23	724	None	12	Southeast
0300	23	724	None	13	South southeast
0400	23	724	None	10	South southeast
0500	21	723	None	9	South
0600	21	723	None	9	South southeast
0700	23	723	None	9	South southeast
0800	25	725	None	9	South southeast
0900	25	725	None	11	South southeast
1000	26	725	None	10	South
1100	26	725	None	12	South
1200	27	725	None	15	South
1300	29	725	None	15	South
1400	29	725	None	12	South
1500	29	725	Rain	10	Northwest

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Table B-1. HCB AND HCB-D CONCENTRATIONS IN AIR SAMPLES FROM VULCAN MATERIALS COMPANY, WICHITA, KANSAS

Sampling station	Sampling time	Volume sampled (liter)	Type of sample	HCB		HCB-D	
				Total ng	µg/m ³ /	Total ng	µg/m ³ /
1	1935-2035	26	Filter Tenax	5 10	0.6	< 1 425	16.4
	0120-0227	42	Filter Tenax	< 2 7	0.2	< 1 560	13.3
	0430-0523	33	Filter Tenax	< 2 6	0.2	< 1 210	6.4
	0841-0941	37	Filter Tenax	< 2 10	0.3	< 1 185	3.0
	1320-1424	40	Filter Tenax	4 10	0.4	< 1 135	3.4
2	1935-2035	17	Filter Tenax	167 25	11.3	< 1 200	11.9
	0120-0227	36	Filter Tenax	< 2 18	0.6	< 1 455	12.6
	0430-0523	29	Filter Tenax	< 2 (45)	1.6	< 1 825	28.4
	0841-0941	32	Filter Tenax	< 2 7	0.3	< 1 205	6.4
	1320-1424	35	Filter Tenax	< 2 32	1.0	< 1 370	10.6
3	1935-	Lost	Filter Tenax				
	0120-0227	57	Filter Tenax	< 2 5	0.1	< 1 310	5.4
	0430-0523	45	Filter Tenax	< 2 6	0.2	< 1 185	4.1
	0841-0941	51	Filter Tenax	< 2 8	0.2	< 1 150	3.0
	1320-1424	54	Filter Tenax	65 25	1.7	< 1 545	10.1
4	1945-2045	27	Filter Tenax	275 35	11.5	< 1 1,550	57
	0110-0220	32	Filter Tenax	2.5 18	0.6	< 1 2,083	65
	0450-0555	30	Filter Tenax	< 2 20	0.8	< 1 1,938	65
	0902-1010	31	Filter Tenax	270 30	9.7	< 1 1,600	52
	1307-1425	36	Filter Tenax	144 36	5.0	< 1 1,750	49

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Table B-1. (continued)

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Sampling station	Sampling time	Volume sampled (liter)	Type of sample	NCB		NCBD	
				Total ng	pg/m ³	Total ng	pg/m ³
5	1945-2045	41	Filter Tenax	100 40	3.4	< 1 700	17
	0110-0220	48	Filter Tenax	38 15	1.1	ND 850	18
	0450-0555	44	Filter Tenax	2.2 12	0.4	< 1 2,250	51
	0902-1010	46	Filter Tenax	50 16	1.4	< 1 1,650	36
	1307-1425	53	Filter Tenax	75 3.3	1.5	< 1 < 1	< 0.02
6	1945-2045	34	Filter Tenax	< 2 38	1.1	< 1 695	20
	0110-0220	40	Filter Tenax	< 2 18	0.5	< 1 345	9
	0450-0555	37	Filter Tenax	< 2 14	0.4	< 1 928	25
	0902-1010	39	Filter Tenax	900-21 21	23.6	< 1 1,712	44
	1307-1425	45	Filter Tenax	119 20	3.0	< 1 20,867	463
7	1950-2050	148	Filter Tenax	< 2 250	1.7	< 1 475	3.2
	0051-0158	166	Filter Tenax	< 2 125	0.8	< 1 590	3.6
	0456-0555	146	Filter Tenax	< 2 142	1.0	< 1 417	2.8
	0904-1010	163	Filter Tenax	< 2 150	0.9	< 1 1,862	11.4
	1308-1425	190	Filter Tenax	< 2 (275)	1.5	< 1 3,250	17
8	1950-2050	212	Filter Tenax	< 2 116	0.6	< 1 510	2.4
	0103-0202	209	Filter Tenax	< 2 46	0.2	< 1 146	0.7
	0458-0600	220	Filter Tenax	< 2 66	0.3	< 1 1,850	8.4
	0908-1010	227	Filter Tenax	< 2 66	0.3	< 1 4,375	19.2
	1308-1420	255	Filter Tenax	< 2 88	0.4	< 1 3,625	14.2

Table B-1. (continued)

Sampling station	Sampling time	Volume sampled (liter)	Type of sample	HCB		HCB D	
				Total ng	$\mu\text{g}/\text{m}^3$	Total ng	$\mu\text{g}/\text{m}^3$
9	1950-2050	227	Filter Tenax	7 167	0.8	< 1 63	0.3
	0103-0202	223	Filter Tenax	< 2 65	0.3	< 1 83	0.4
	0458-0600	234	Filter Tenax	< 2 114	0.5	< 1 490	2.1
	0908-1010	242	Filter Tenax	< 2 87	0.4	< 1 3,860	16
	1308-1420	272	Filter Tenax	7 135	0.5	< 1 4,631	17
10	1910-2310	809	Filter Tenax	< 2 250	0.3	< 1 9,850	12.2
	0005-0330	691	Filter Tenax	< 2 150	0.2	< 1 4,500	6.5
	0340-0728	768	Filter Tenax	< 2 134	0.2	< 1 2,000	2.6
	0737-1117	741	Filter Tenax	< 2 91	0.1	< 1 1,200	1.6
	1124-1433	637	Filter Tenax	< 2 97	0.2	< 1 438	0.7
11	1910-2310	856	Filter Tenax	< 2 278	0.3	< 1 10,350	12.1
	0005-0330	732	Filter Tenax	< 2 109	0.2	< 1 4,750	6.5
	0340-0728	814	Filter Tenax	< 2 75	0.1	< 1 1,950	2.4
	0737-1117	785	Filter Tenax	< 2 78	0.1	< 1 1,090	1.4
	1124-1433	675	Filter Tenax	Sample lost 106	0.2	Sample lost 408	0.7
12	1919-2315	863	Filter Tenax	14 850	1.0	< 1 17,500	20
	2350-0315	738	Filter Tenax	< 2 300	0.4	< 1 16,333	22
	0325-0712	817	Filter Tenax	815 190	1.2	< 1 4,500	6
	0721-1101	792	Filter Tenax	875 210	1.4	< 1 4,000	5
	1113-1433	720	Filter Tenax	18 260	0.4	< 1 1,833	3

Table B-1. (continued)

Sampling station	Sampling time	Volume sampled (liter)	Type of sample	HCB		HCB D	
				Total ng	µg/m ³	Total ng	µg/m ³
13	1915-2315	917	Filter Tenax	5 950	1.0	< 1 17,000	19
	2350-0315	784	Filter Tenax	91 320	0.5	< 1 17,000	22
	0325-0712	867	Filter Tenax	950 200	1.3	< 1 3,500	4
	721-1101	840	Filter Tenax	900 180	1.3	< 1 3,000	4
	1113-1433	764	Filter Tenax	(980) 280	1.7	< 1 1,400	2
14	1920-2259	806	Filter Tenax	< 2 40	0.1	< 1 3.5	0.004
	2335-0258	816	Filter Tenax	< 2 41	0.1	< 1 150	0.2
	0310-0640	844	Filter Tenax	< 2 60	0.1	< 1 25	0.03
	0650-1046	949	Filter Tenax	< 2 85	0.1	< 1 130	0.1
	1057-1435	876	Filter Tenax	< 2 225	0.3	< 1 3,642	4.2
15	1920-2259	837	Filter Tenax	< 2 25	0.03	< 1 13.5	0.02
	2335-0258	805	Filter Tenax	< 2 60	0.1	< 1 160	0.2
	0310-0640	832	Filter Tenax	< 2 97	0.1	< 1 46	0.1
	0650-1046	935	Filter Tenax	< 2 81	0.1	< 1 164	0.2
	1057-1435	863	Filter Tenax	5 200	0.2	< 1 3,300	3.8
16	2005-0010	862	Filter Tenax	4 330	0.4	< 1 133	0.2
	0025-0345	702	Filter Tenax	< 2 138	0.2	< 1 30	0.04
	0355-0744	804	Filter Tenax	< 2 160	0.2	< 1 48	0.1
	0752-1154	849	Filter Tenax	21 230	0.3	ND ND	ND
	1200-1430	527	Filter Tenax	< 2 440	0.8	ND 29	0.1

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Table B-1. (concluded)

Sampling station	Sampling time	Volume sampled (liter)	Type of sample	HCB		HCB-D	
				Total ng	$\mu\text{g}/\text{m}^3$	Total ng	$\mu\text{g}/\text{m}^3$
17	2005-0010	730	Filter	ND ^{b/}	0.6	ND	0.003
			Tenax	420		2	
	0025-0345	596	Filter	< 2	0.3	ND	0.008
			Tenax	200		5	
	0355-0744	682	Filter	950	1.6	ND	0.007
			Tenax	130		5	
	0752-1154	721	Filter	21	0.8	ND	0.01
			Tenax	350		9	
	1200-1430	447	Filter	925	2.1	ND	0.02
			Tenax	330		9	
18	2010-	548	Filter	9	0.7	< 1	0.2
			Tenax	395		130	
	0022-0355	711	Filter	< 2	0.3	< 1	0.1
			Tenax	230		54	
	0400-0755	785	Filter	935	1.6	< 1	0.1
			Tenax	280		61	
	0759-1121	858	Filter	3	0.6	< 1	0.1
			Tenax	490		123	
	1215-1430	451	Filter	10	0.7	< 1	0.1
			Tenax	320		39	
Tenax GC blank					ND		ND
Millipore filter blank					ND		ND

^{a/} Concentration based on the sum of ng found on the filter and Tenax.

^{b/} ND - None detected.

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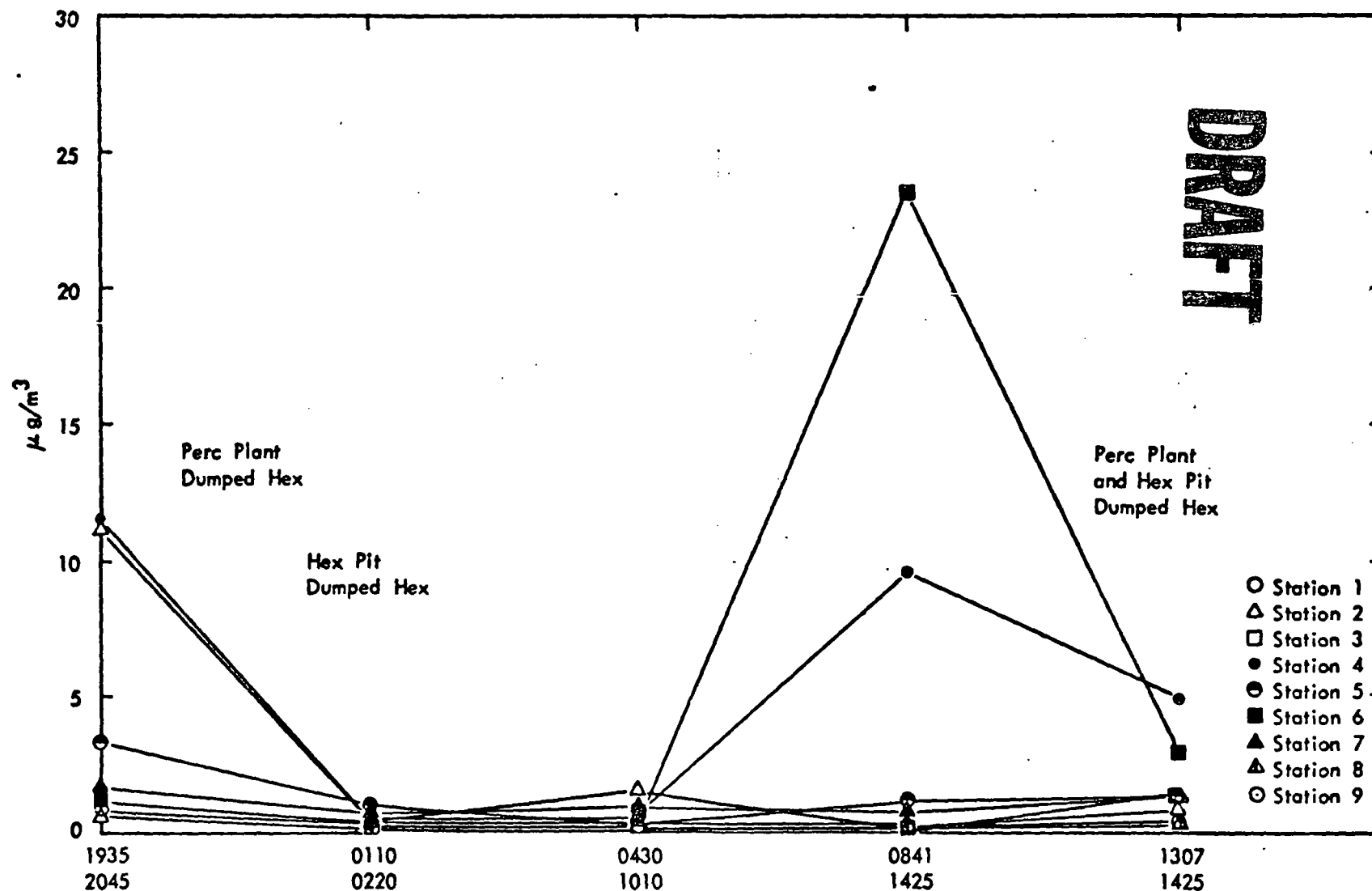


Figure B-1. HCB concentration per 20-hr period at sampling stations within the plant perimeter (Vulcan)

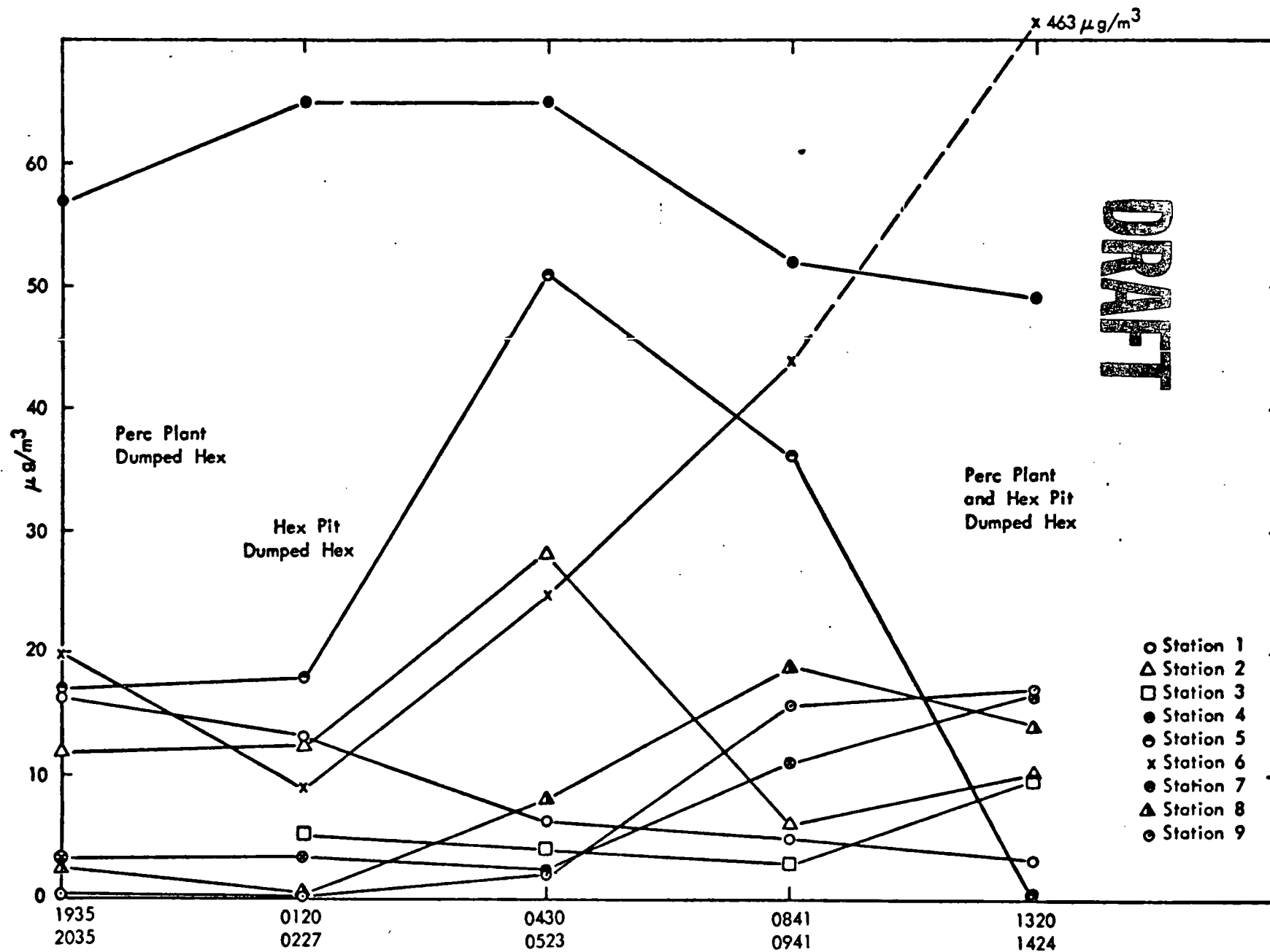


Figure B-2. HCBd concentration per 20-hr period at sampling stations within the plant perimeter (Vulcan)

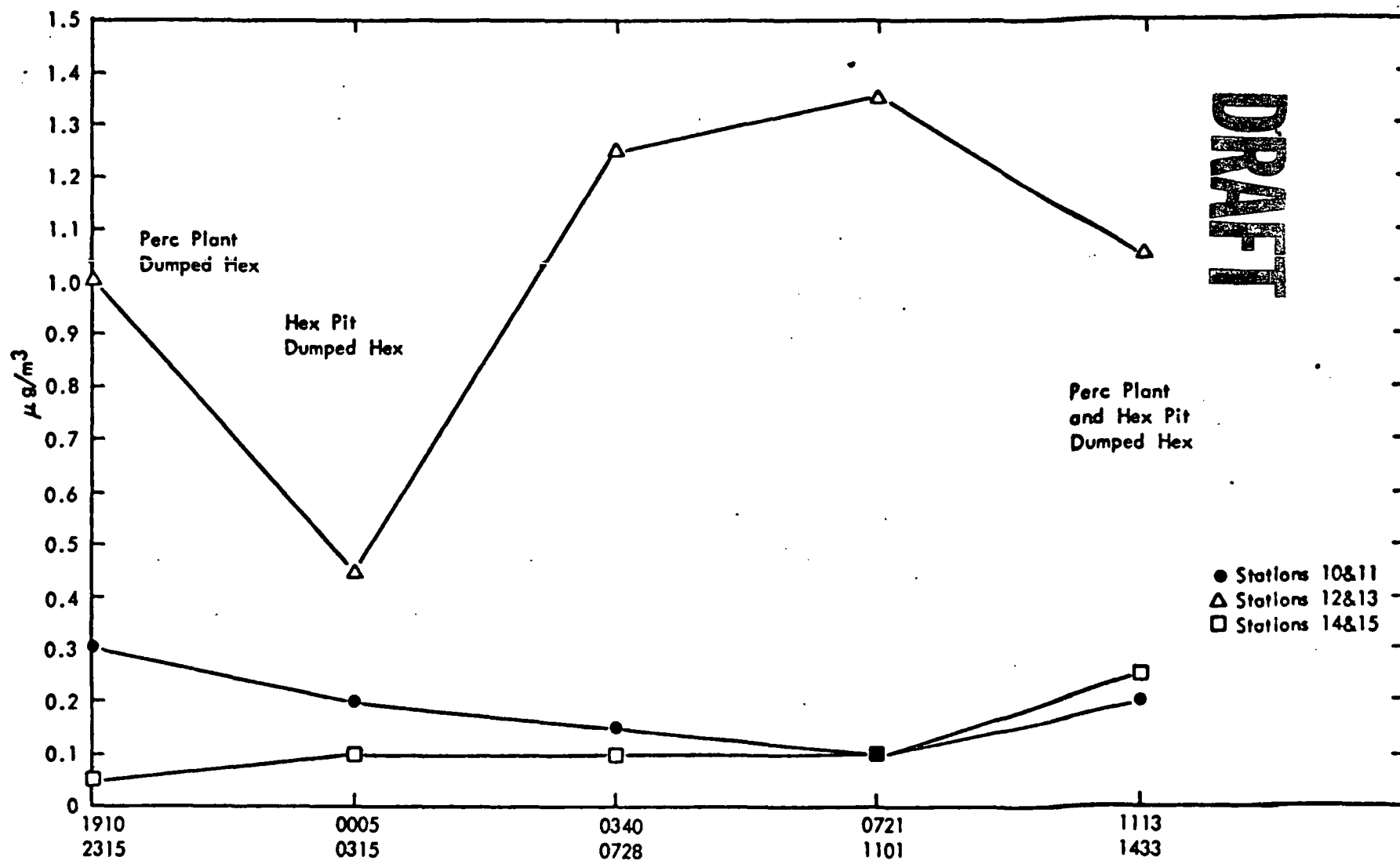


Figure B-3. HCB concentration per 20 hr period, downwind stations (Vulcan)

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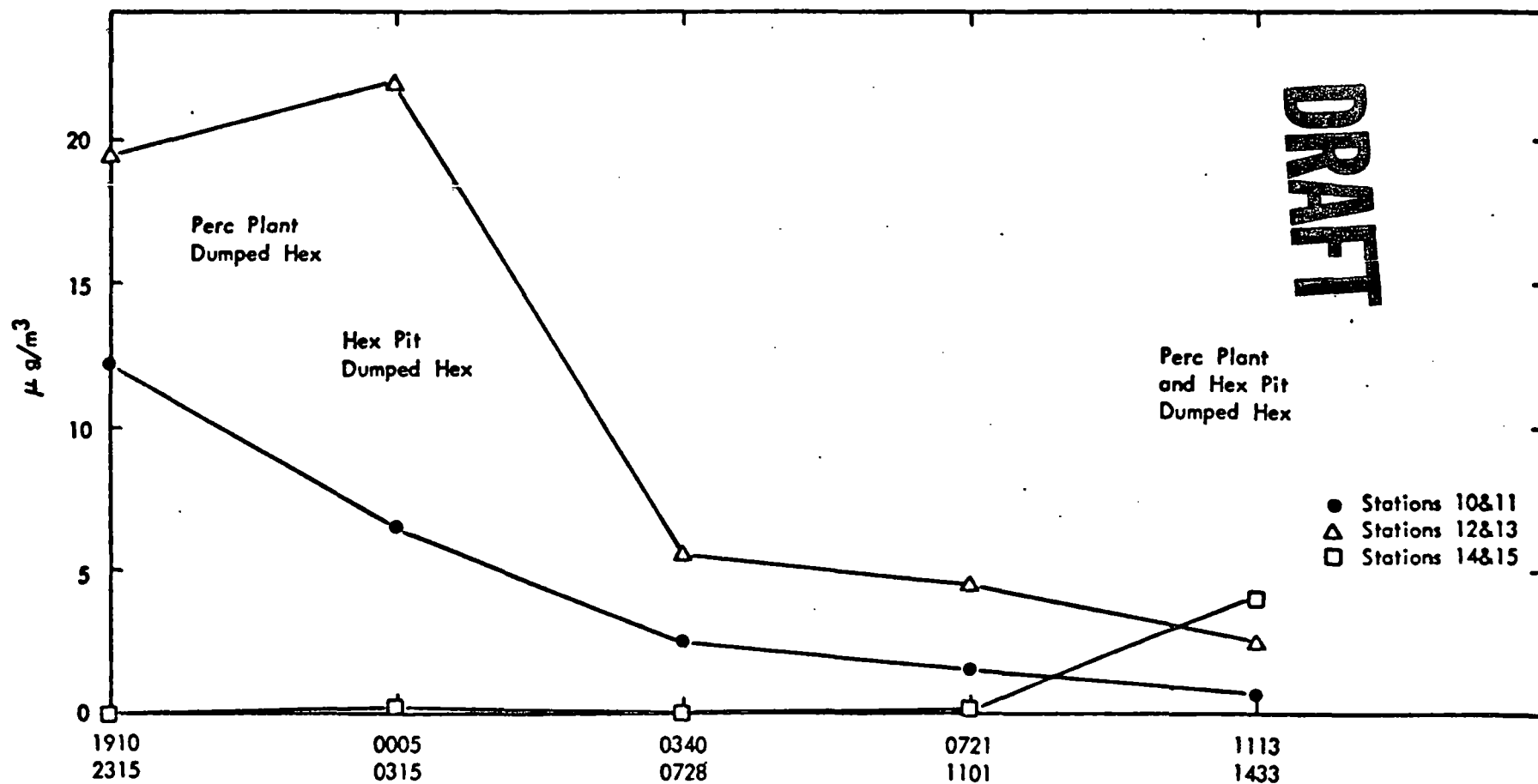


Figure B-4. HCBd concentration per 20 hr period, downwind stations (Vulcan)

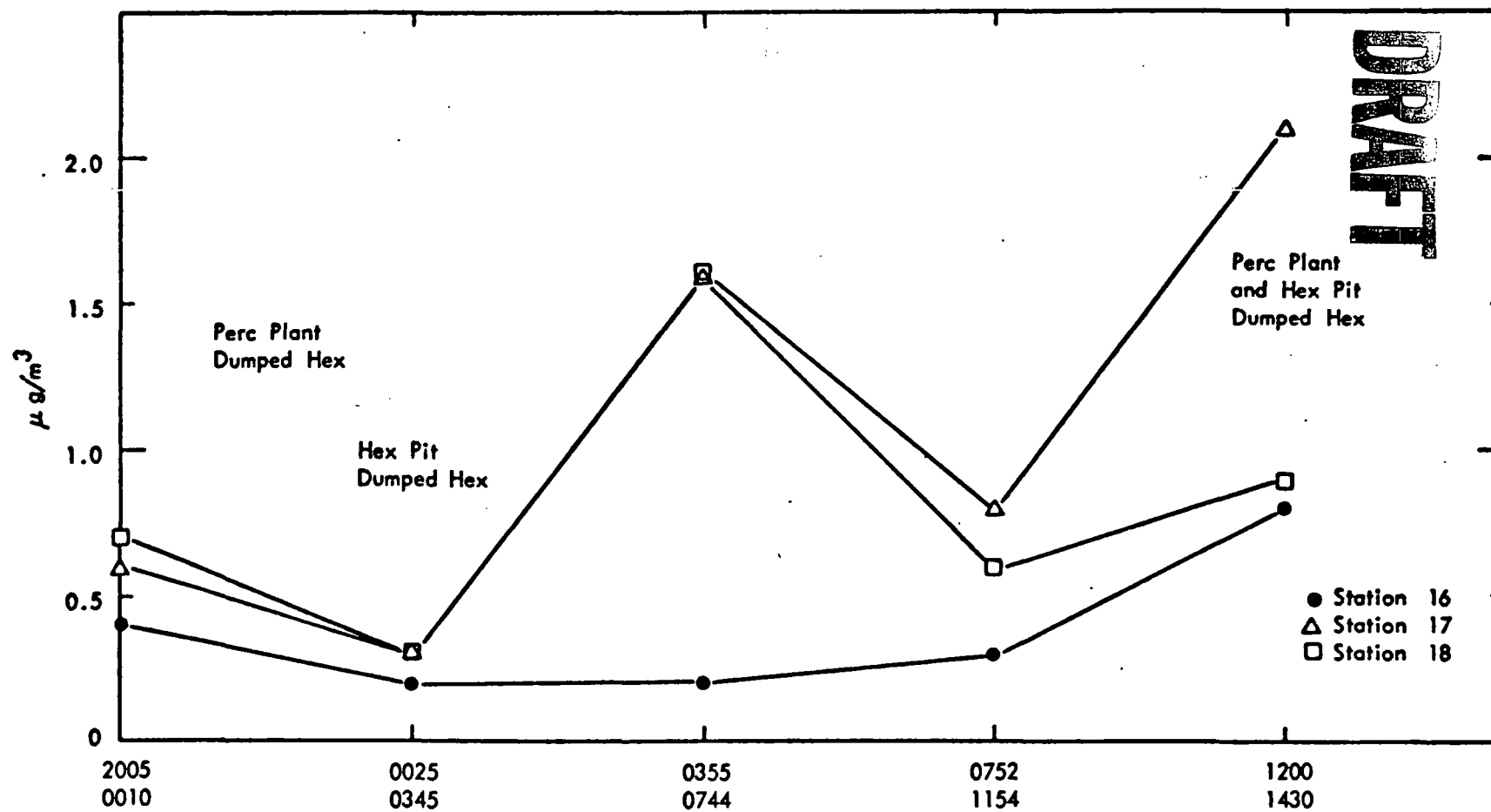


Figure B-5. HCB concentration per 20 hr period, upwind stations (Vulcan)

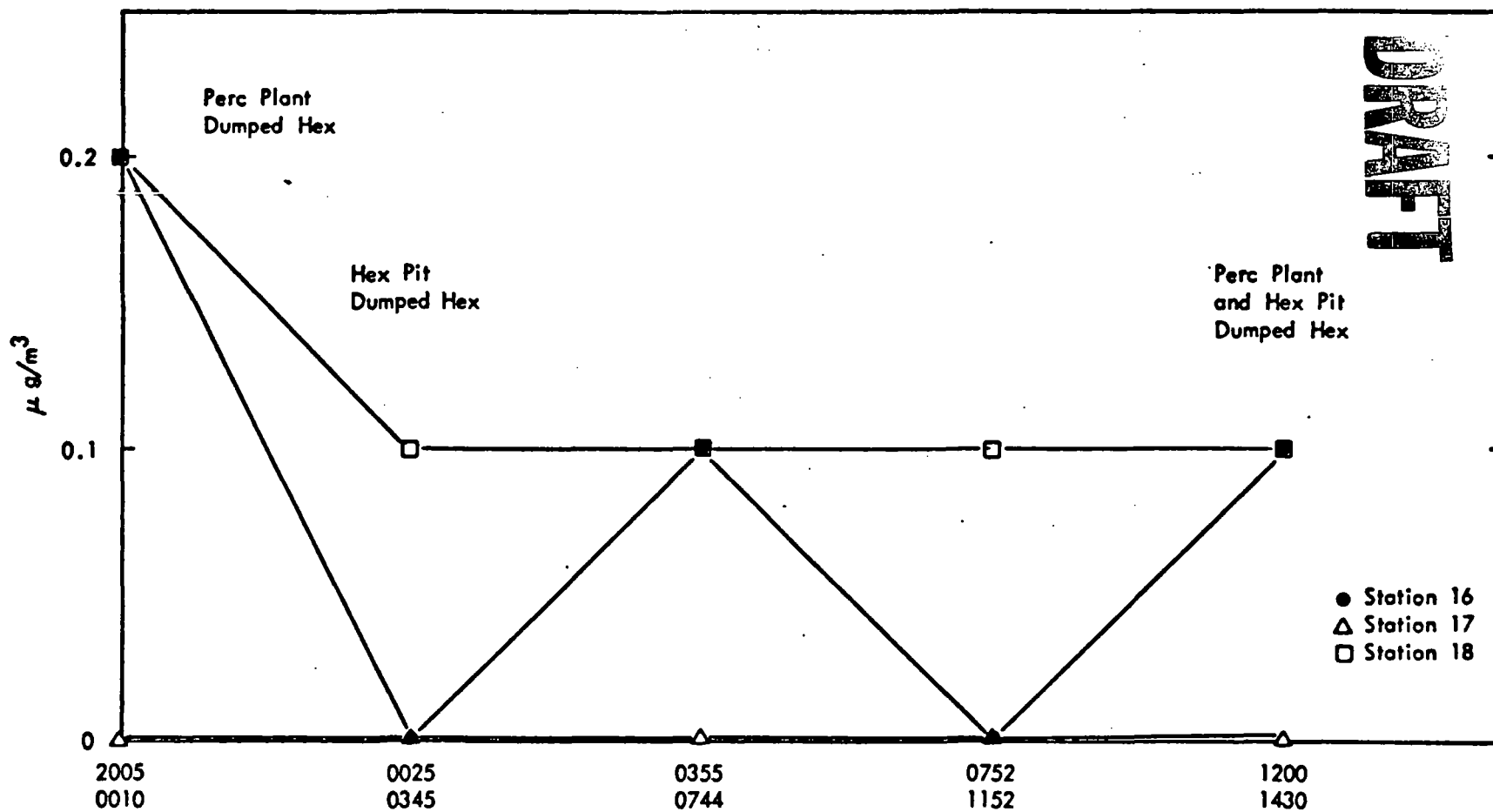


Figure B-6. HCBD concentration per 20 hr period, upwind stations (Vulcan)

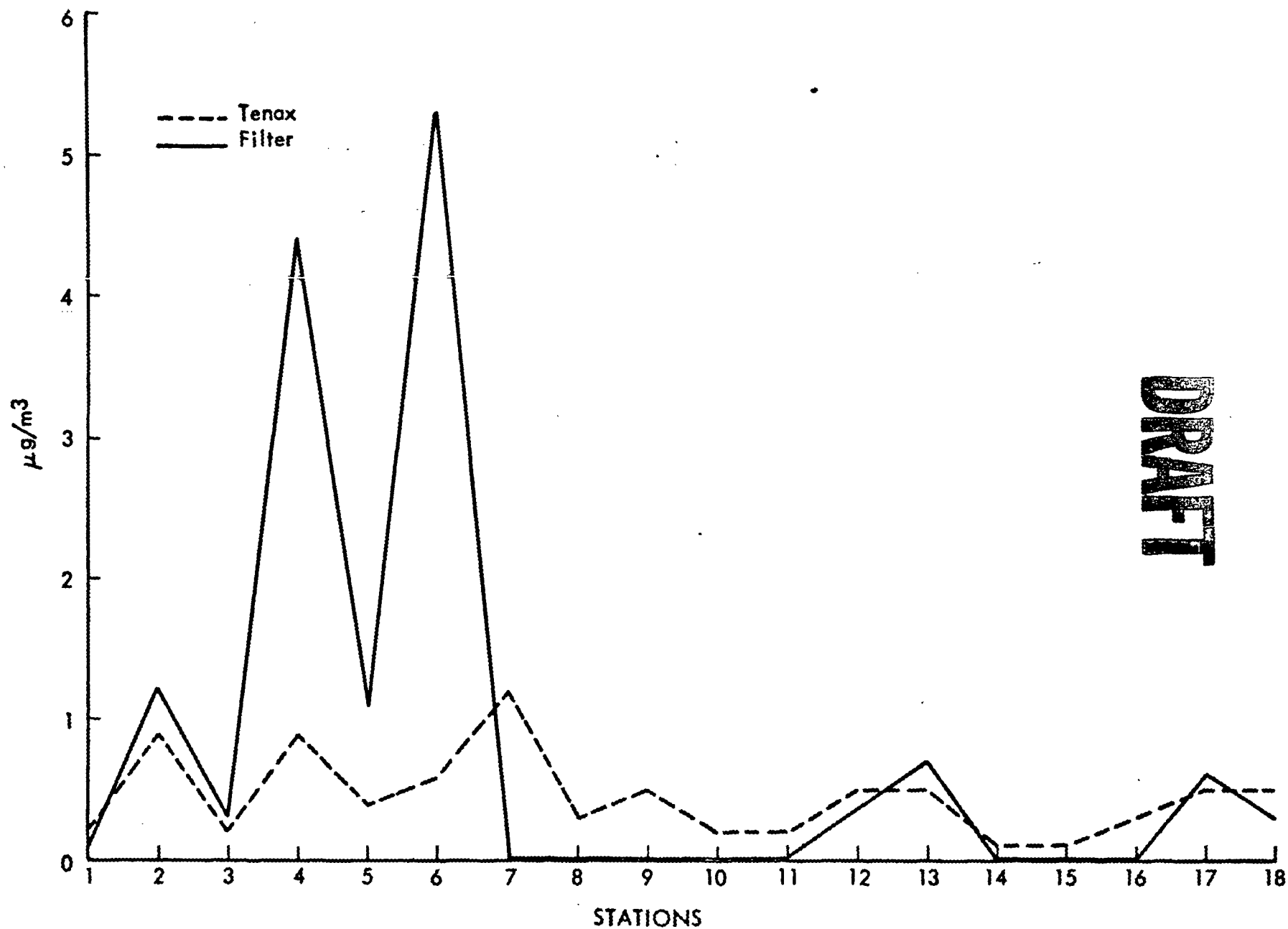


Figure B-7. Average vapor and particulate concentrations of HCB in air per 20-hr period at 18 sampling stations (Vulcan)

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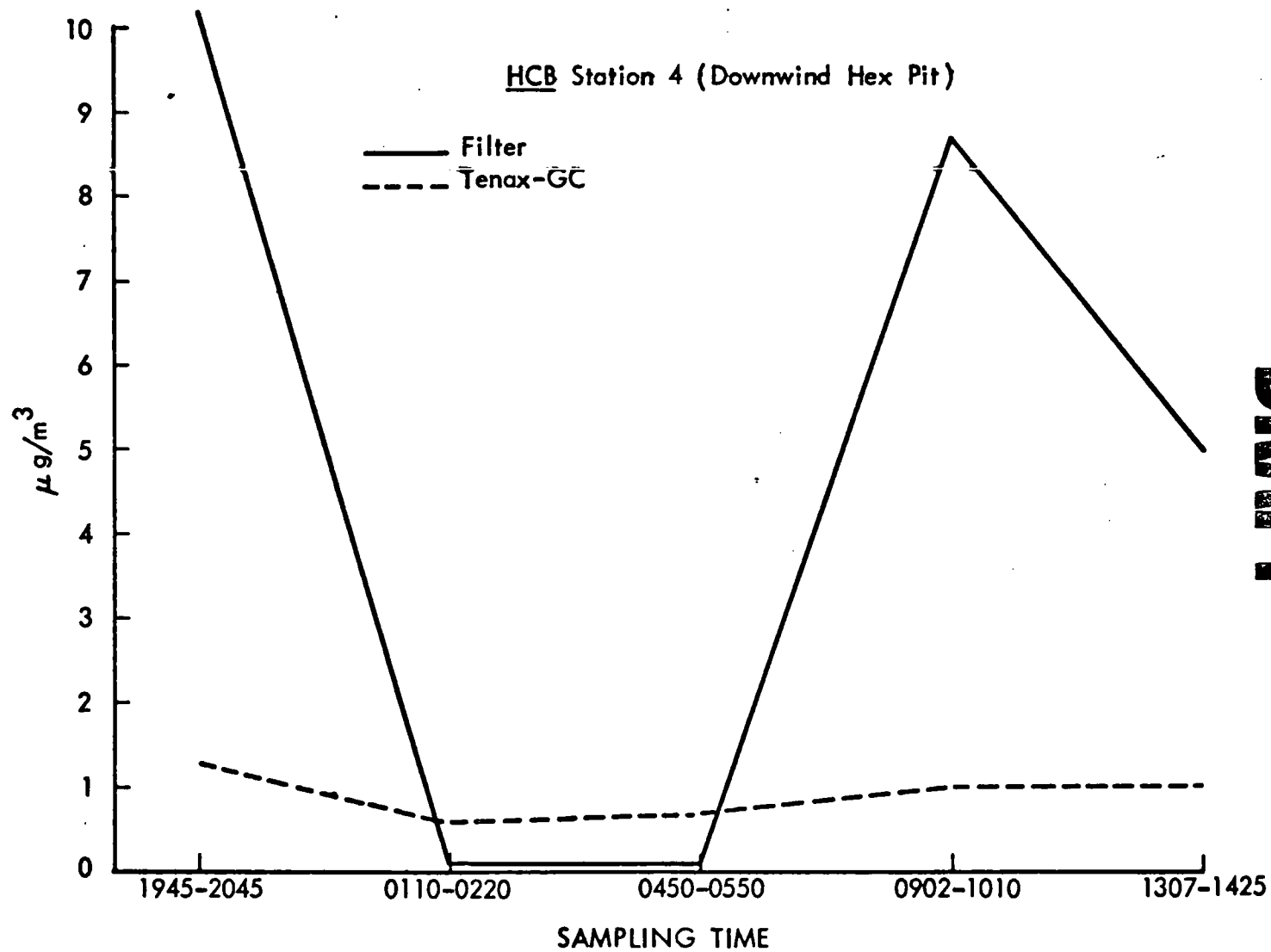
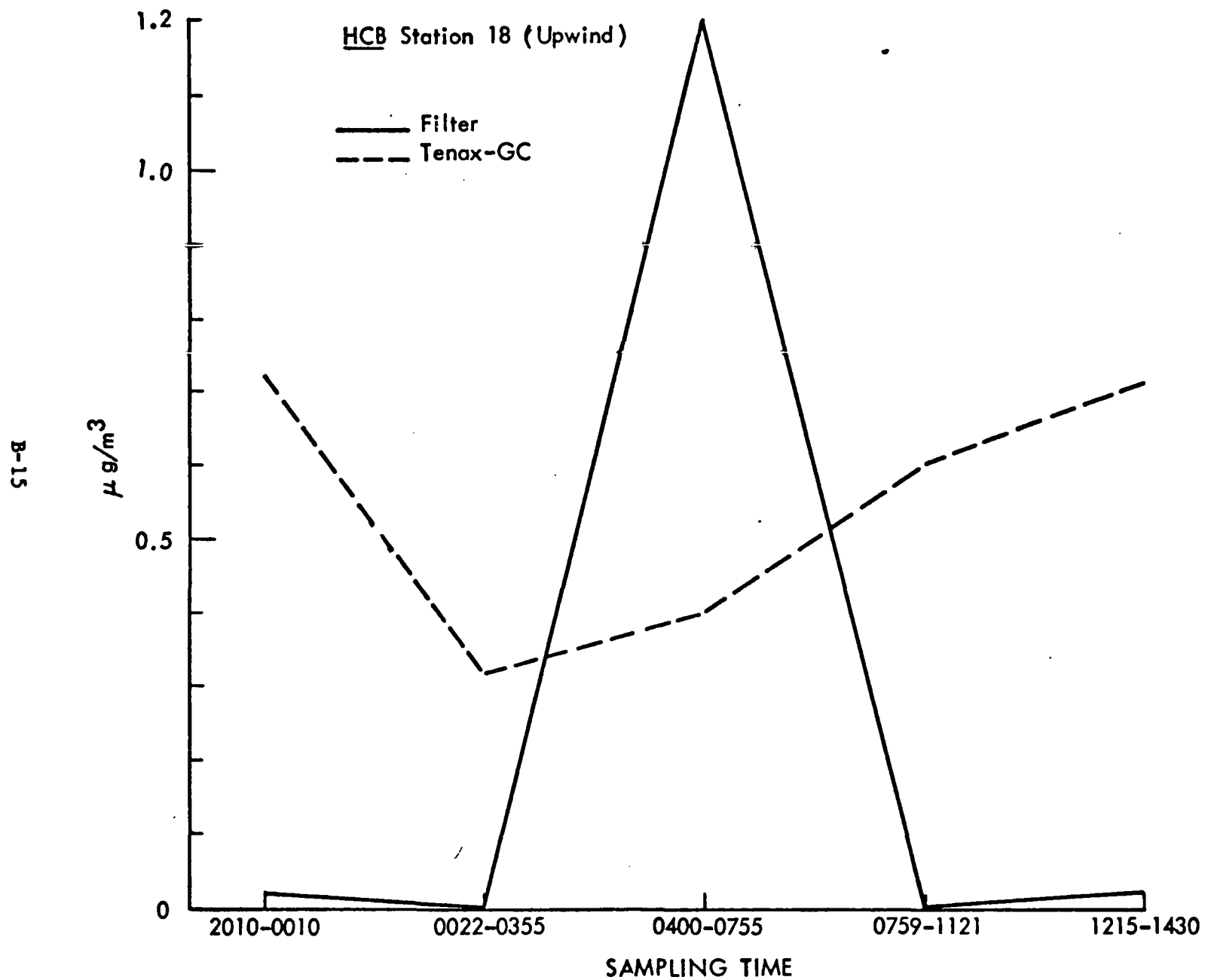


Figure B-8. Variation in vapor and particulate HCB levels at Station 4 (Vulcan)



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Figure B-9. Variation in vapor and particulate HCB levels at Station 18 (Vulcan)

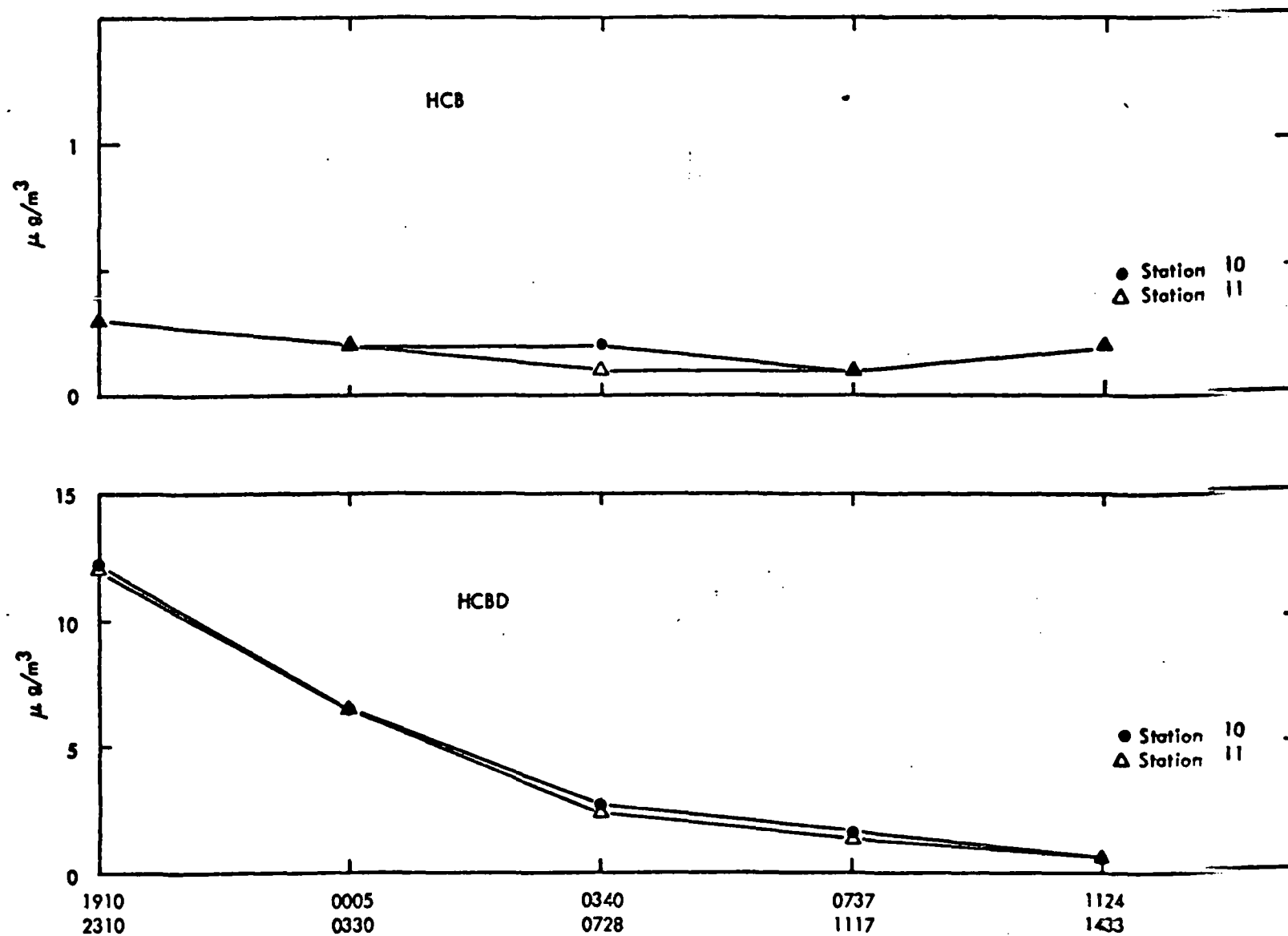


Figure B-10. Comparison of HCB and HCBd concentrations at Stations 10 and 11 (Vulcan)

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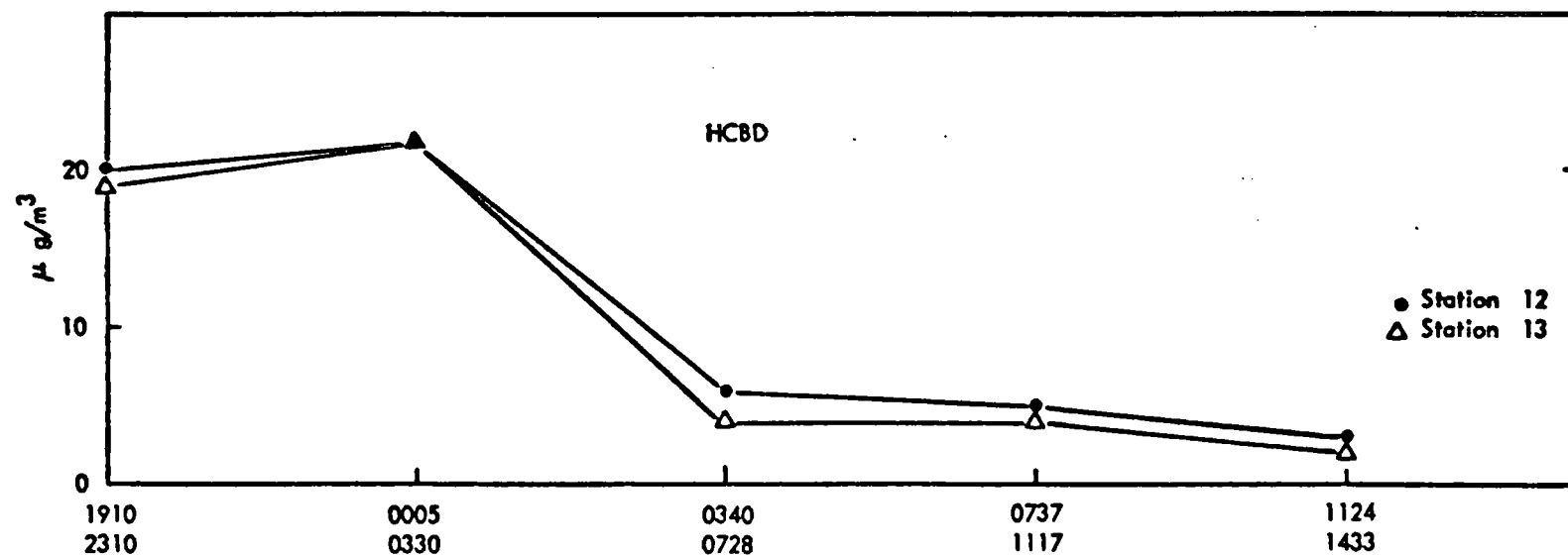
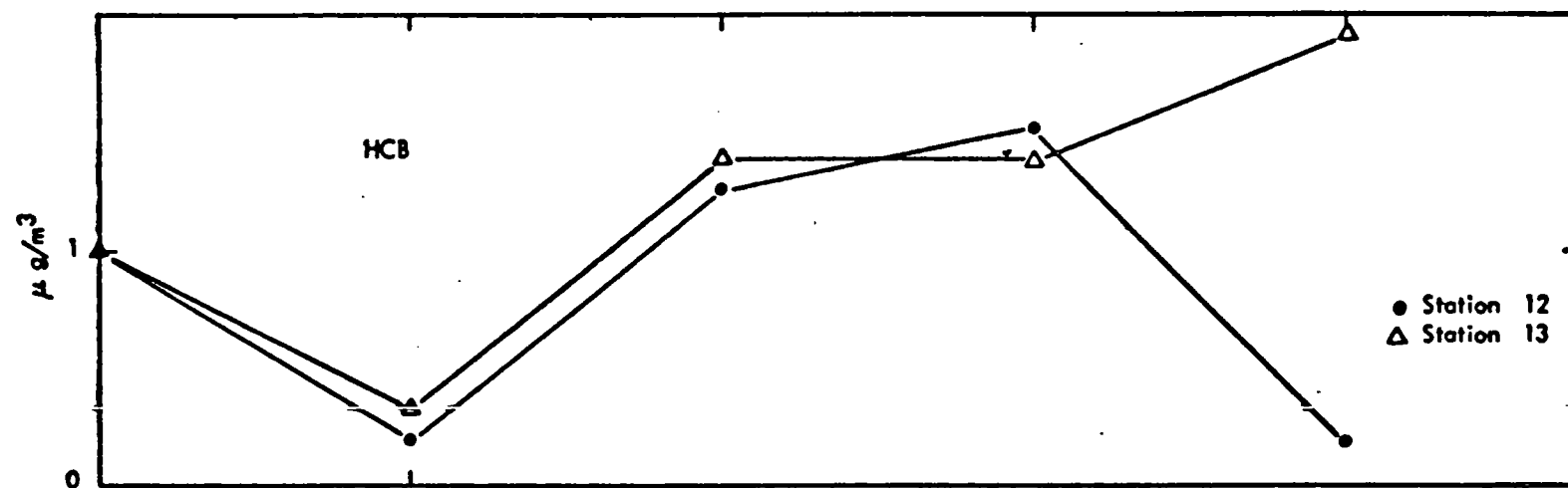


Figure B-11. Comparison of HCB and HCBD concentrations at Stations 12 and 13 (Vulcan)

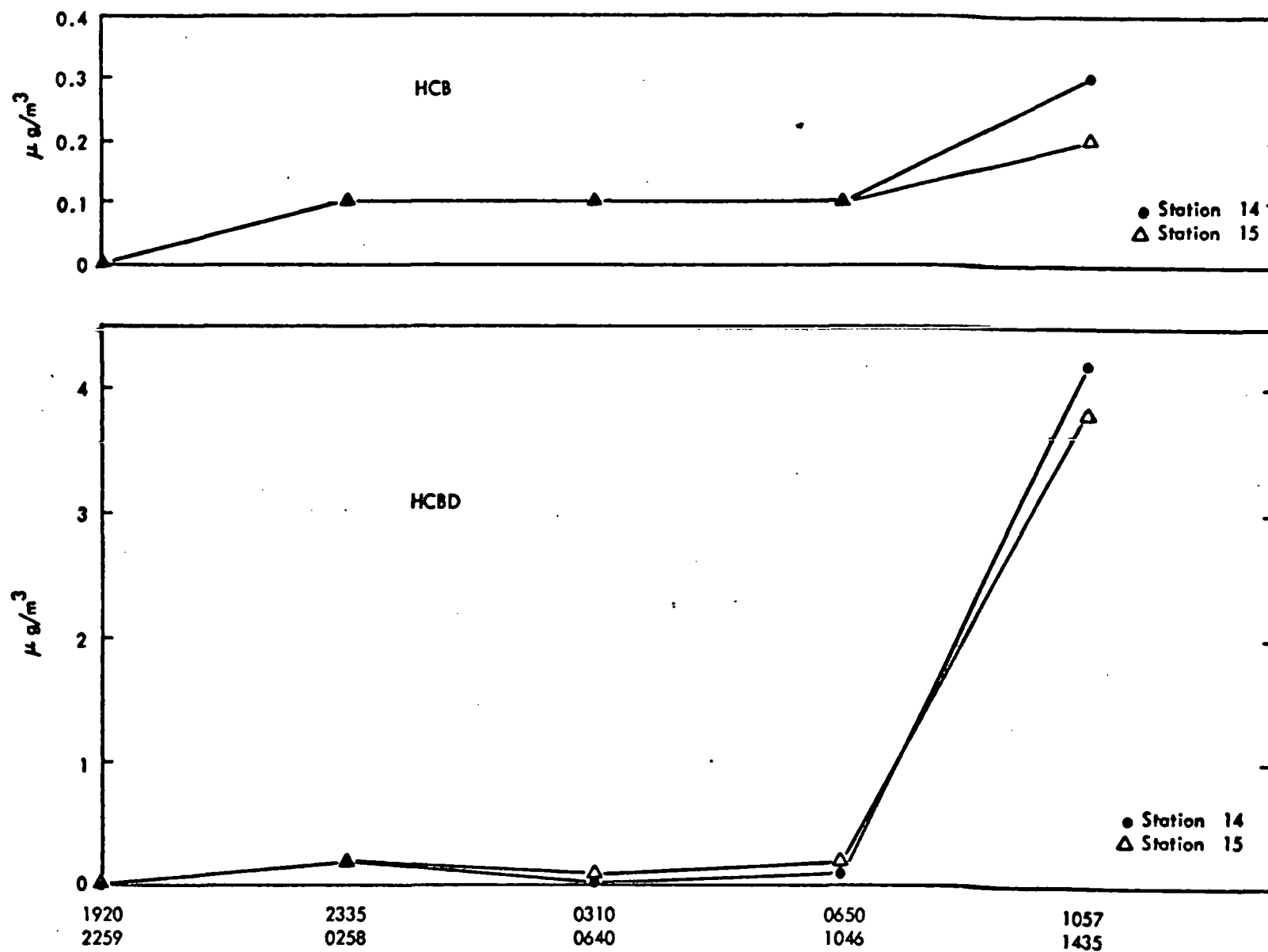


Figure B-12. Comparison of HCB and HCBD concentrations at Stations 14 and 15 (Vulcan)

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**Table B-2. HCB AND HCBD CONCENTRATIONS IN SOIL AND SEDIMENT
FROM VULCAN MATERIALS COMPANY, WICHITA, KANSAS**

<u>Samples^{a/}</u>	<u>Sample weight (g)</u>	<u>Concentration (µg/g)</u>	
		<u>HCB</u>	<u>HCBD</u>
S-2	42.8	109	2.28
S-3	2.5	5%	980
S-4	48.4	157	0.22
S-5	38.7	1,453	0.36
S-6	40.5	5.6	0.049
S-7	29.6	1.3	0.030
S-8	35.6	126	0.106
S-9	43.5	1.2	0.018
S-10	34.2	1.1	0.005
"Hex Pit" solids	0.95	21%	10%
Control		ND	ND

- a/ S-2 - Route from "Perc Plant" to "Hex Pit."
S-3 - "Hex Pit."
S-4 - Route from "Hex Pit" to landfill.
S-5 - Landfill (60 yards north of 63rd Street and 0.4 miles east of Ridge Road.
S-6 - Landfill (180 yards north of 63rd Street and 0.4 miles east of Ridge Road.
S-7 - Landfill (Ridge Road to telephone pole).
S-8 - Upwind.
S-9 - Downwind.
S-10 - Western boundary (cornfield).
Control - Soxhlet apparatus.

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**Table B-3. HCB AND HCB_D CONCENTRATIONS IN WATER FROM VULCAN
MATERIALS COMPANY, WICHITA, KANSAS**

<u>Samples</u>	<u>Volume sampled (liter)</u>	<u>Concentration (µg/l)</u>	
		<u>HCB</u>	<u>HCB_D</u>
"Hex Pit" water	0.315	306	231
Solar Pond	0.335	0.7	2.2
Upstream (Cowskin Creek)	323	0.009	ND
Downstream (Cowskin Creek)	365	0.018	ND

ND - None detected.